

# Motorcycle Active Safety (Crash Avoidance)

See and Be Seen  
Maintain Stability  
Proper Training



BMW Motorrad

Washington, DC  
September 2006



# Lighting Technology for Active Safety

## “See and be seen”

### Day

**Recognition by other road users**  
**Allow estimation of speed / distance**



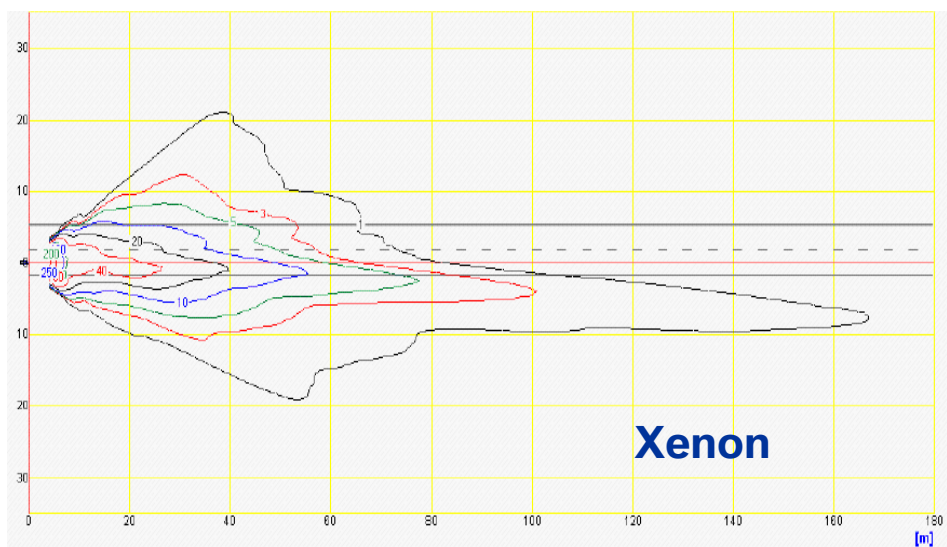
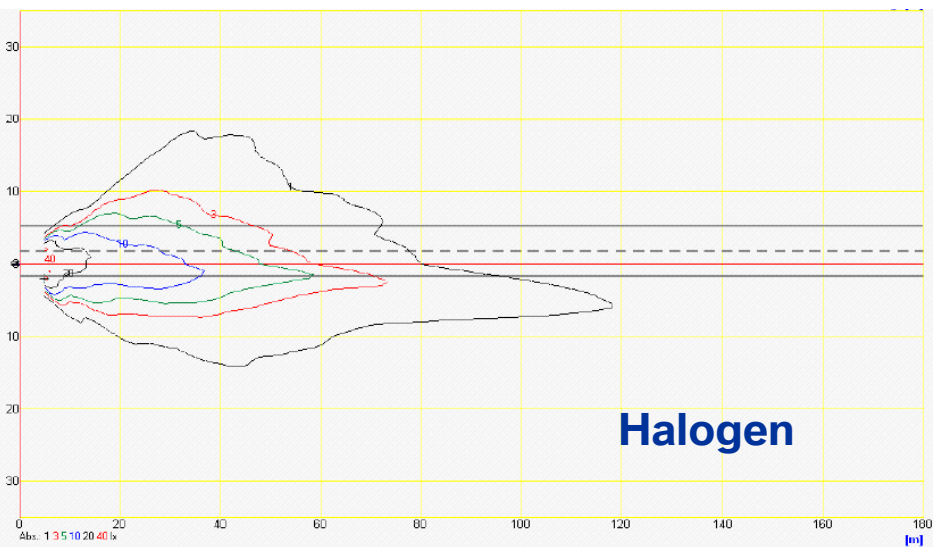
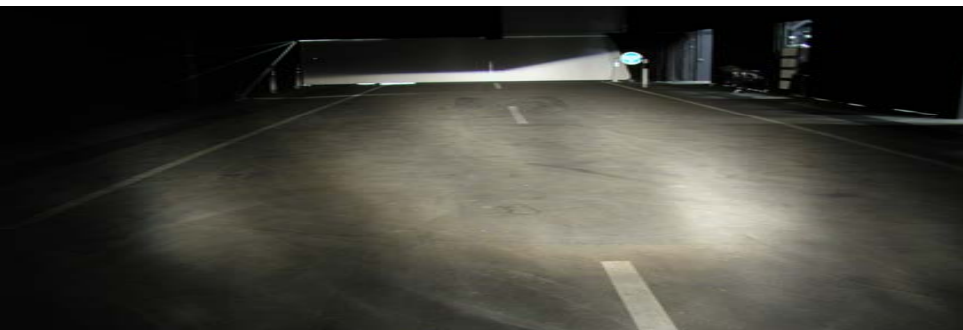
### Night

**Good light distribution**  
**Optimum range**  
**Resolution for risk identification**  
**Minimum glare**



# Xenon Headlamps (High Intensity Discharge)

## Comparision



# Xenon Headlamps

## luminous flux

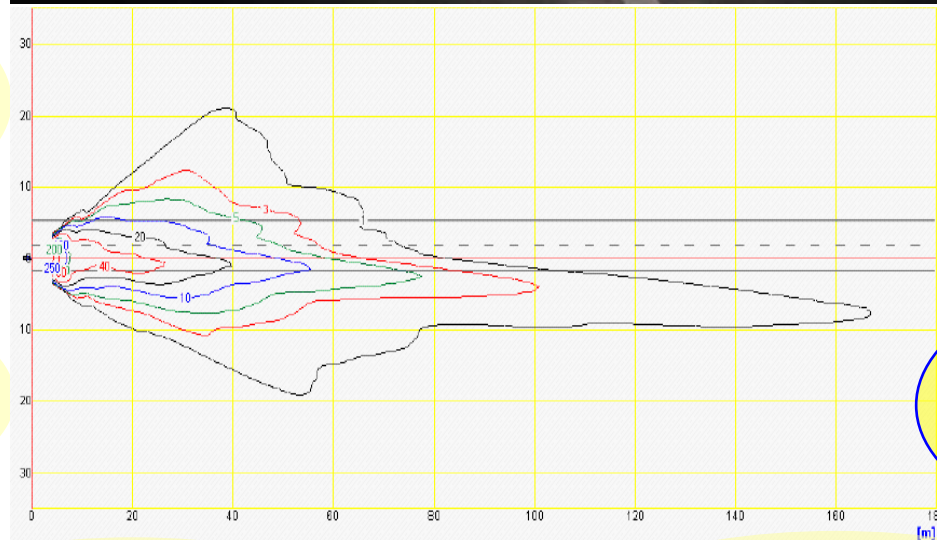
(2-2,5 times more)

## light color

Similar to daylight 4200K  
Less tiring

## constant power output

Less variation



## illumination

Better uniformity  
Increased range

## perception of colors

True colors

## safety / comfort Improvement

field of view extended  
higher attention level

## life time (bulb)

corresponds to life of the bike

## power consumption

30% less electrical consumption  
fuel savings

# **Tire Pressure Monitoring (RDC)**

## **“Maintain Stability”**

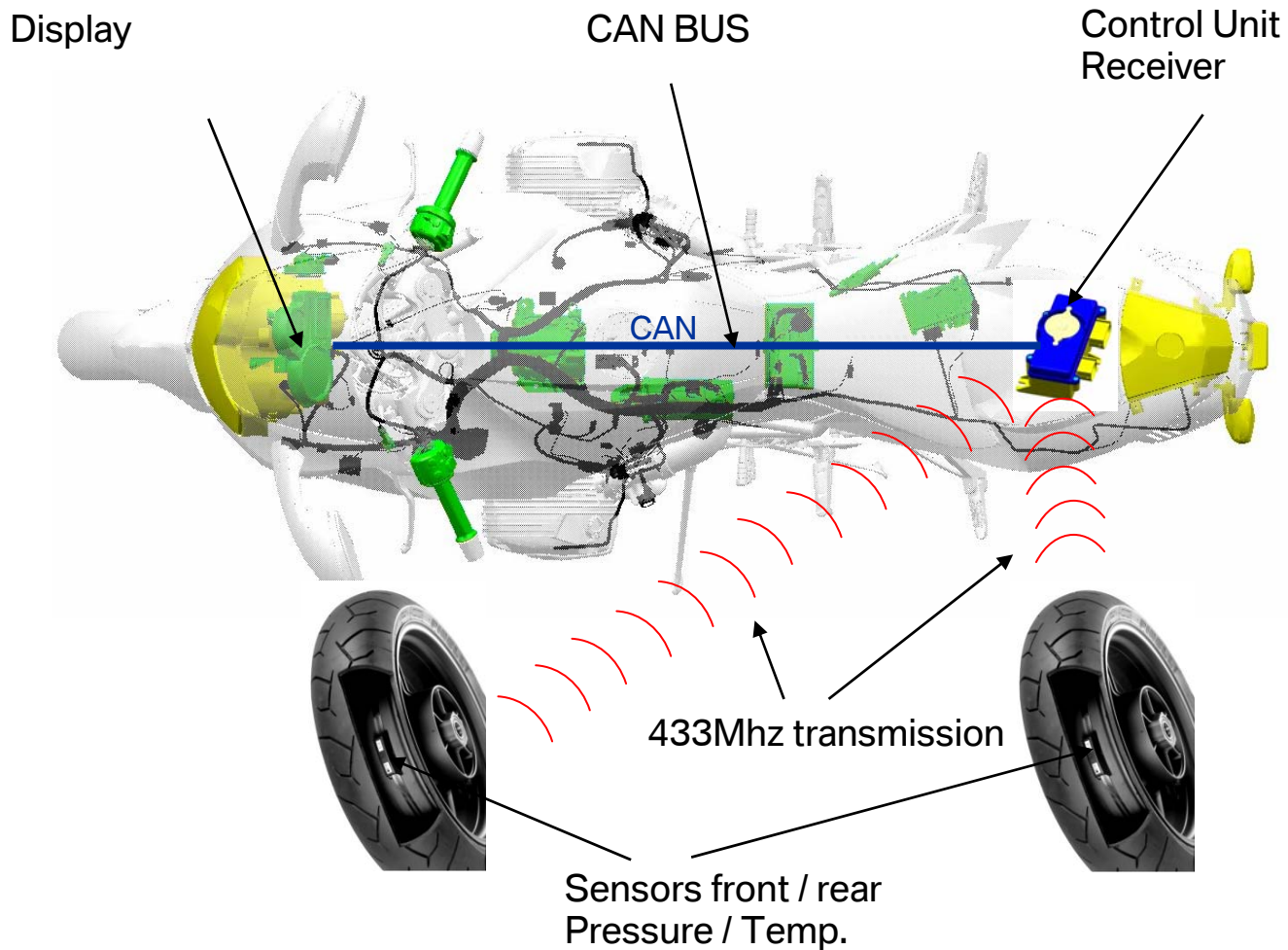
### **Correct tire pressure is crucial!**

The BMW Tire Pressure Monitoring system (RDC) provides reliable information on the current tire pressure.

Significant pressure loss: a yellow or red lamp warning

# Tire Pressure Monitoring (RDC)

## Top View





# RDC

## Information / Warnings



### Information

tire pressure values  
front/rear indicated



### Warning

Incorrect tire pressure  
- value is blinking -



### Alert

Incorrect tire pressure  
- value is blinking -

# The New Integral ABS

“Maintain Stability”



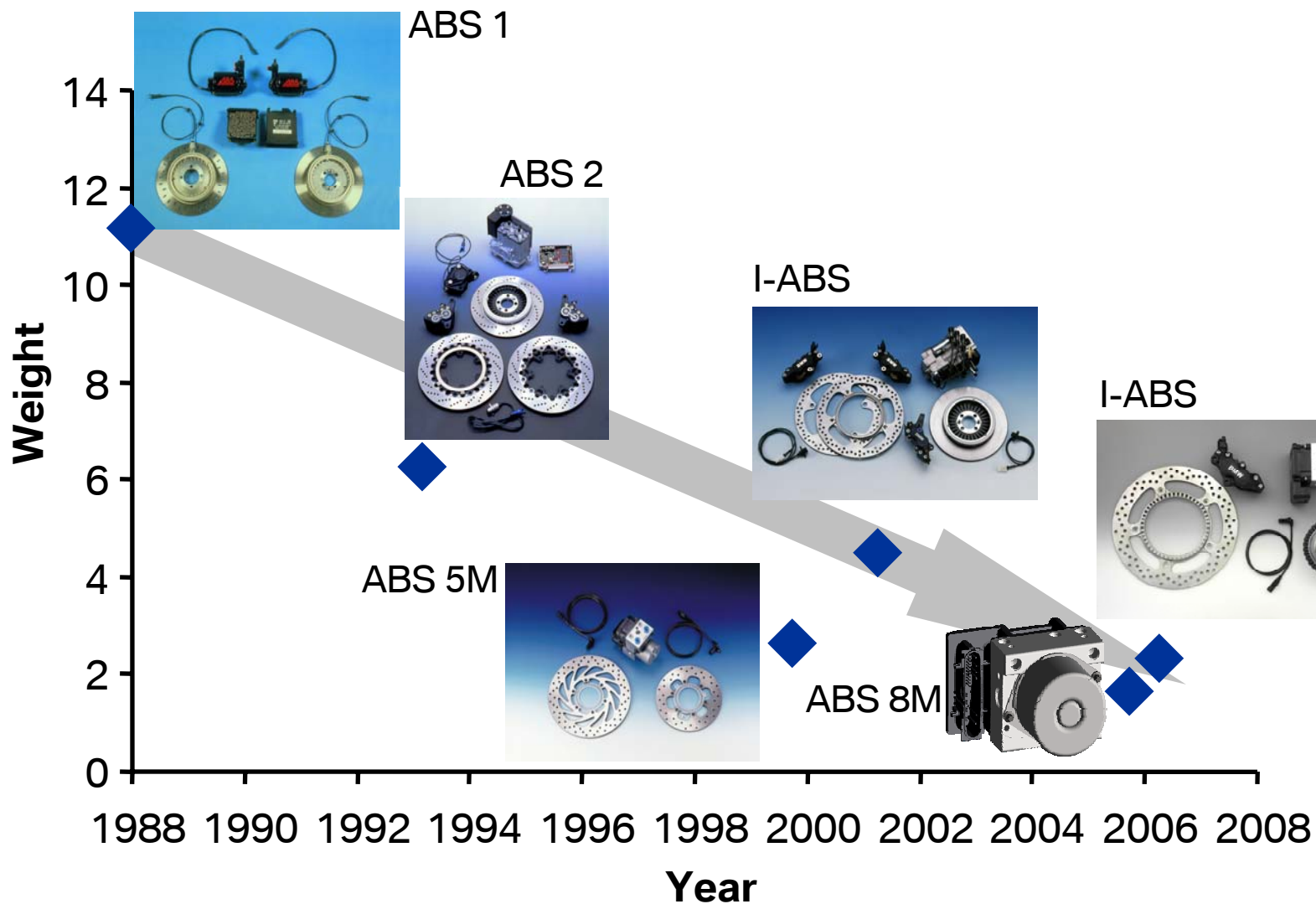


# Why ABS?



# The new Integral ABS

## Evolution of ABS.



# **The new Integral ABS**

## **Development of Integral ABS.**

### **Development targets of Integral ABS**

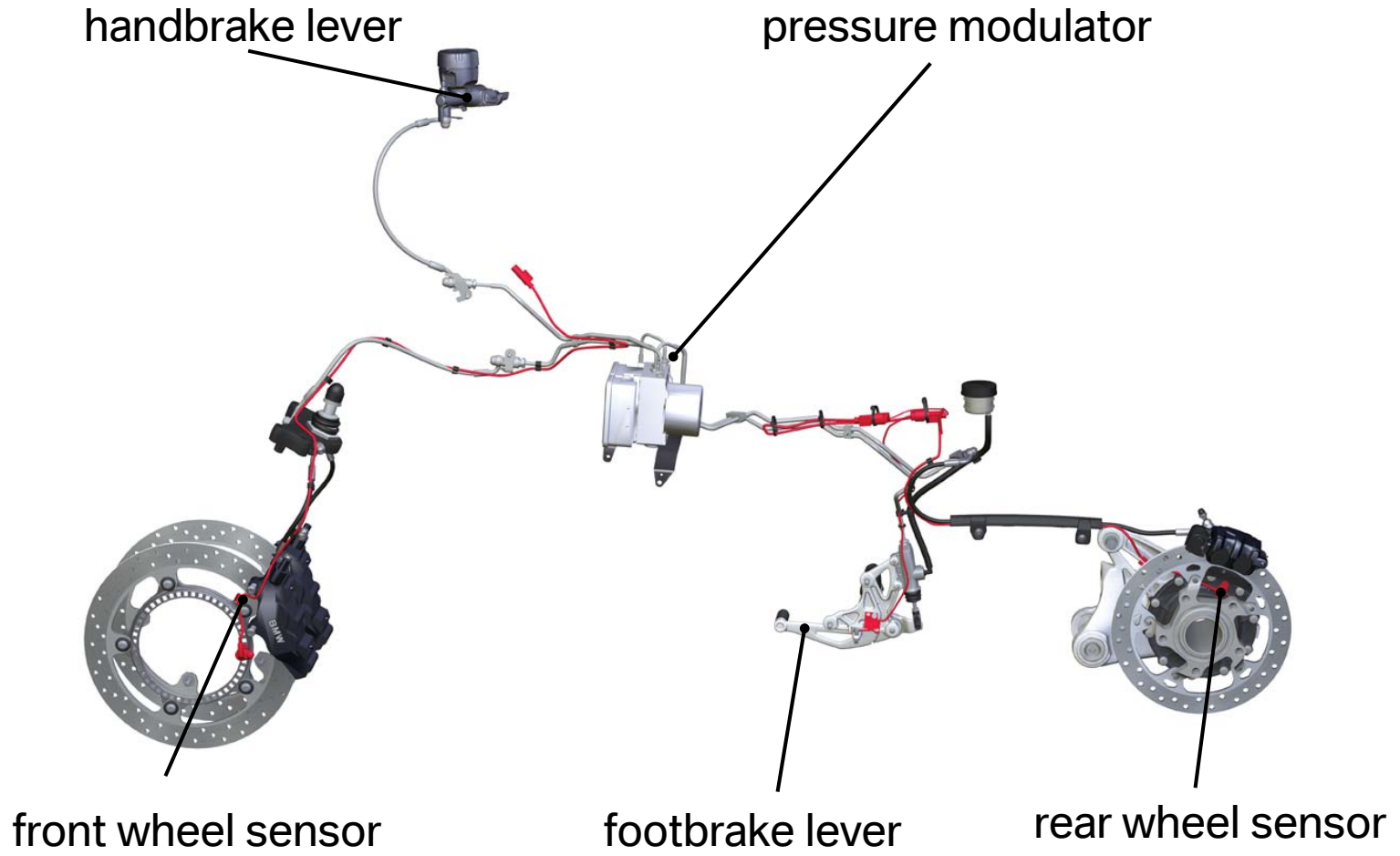
- Shorter stopping distance.
- Excellent response.
- Simplification of system architecture.
- Optimum distribution of brake forces on front and rear wheel.
- Load condition taken into account.
- Improvement of brake feel.
- Weight reduction.
- Complete self-diagnosis.
- Easy to operate.

# The new Integral ABS

## Development

- Further development of ABS valve systems in the automotive sector enables use in motorcycles with integral function.
- Valve systems are a compact unit.
- Simplification of system architecture.
- Integral ABS, derived from automotive Electronic Stability Control, provides the possibility for interfacing with other driving dynamics control systems.

# The new Integral ABS Components

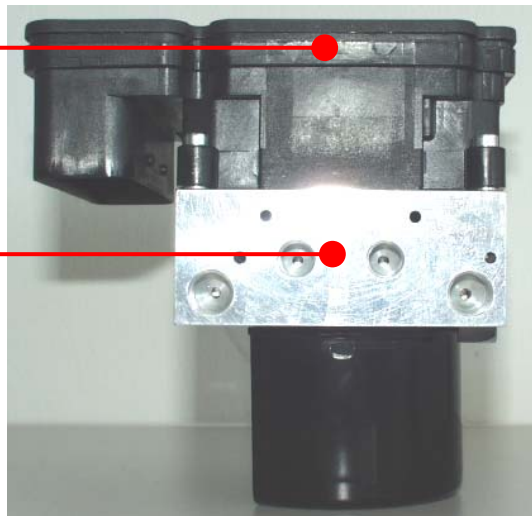


# The new Integral ABS

## Pressure modulator.

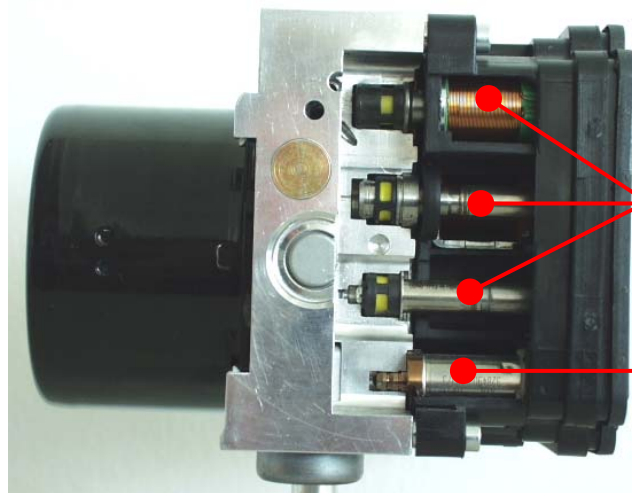
Electronics

Hydraulic  
connector



Valves

Pressure  
sensor

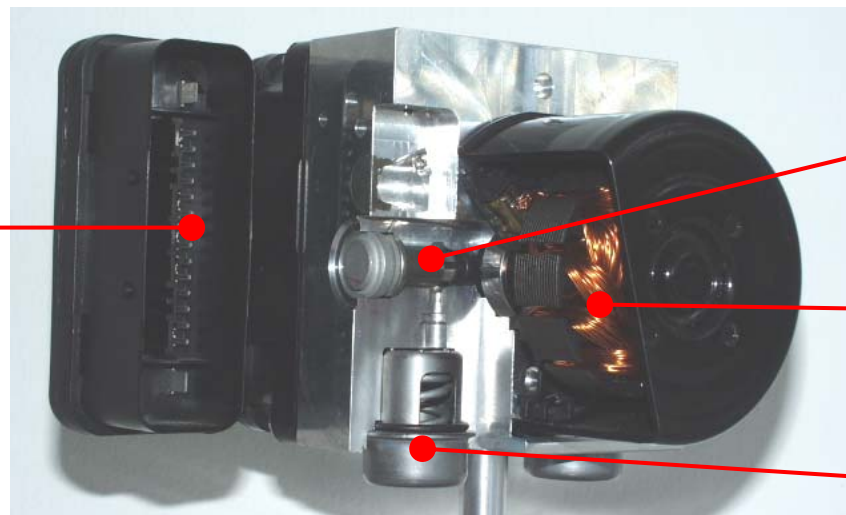


Electrical  
connector

Piston pump

Pump motor

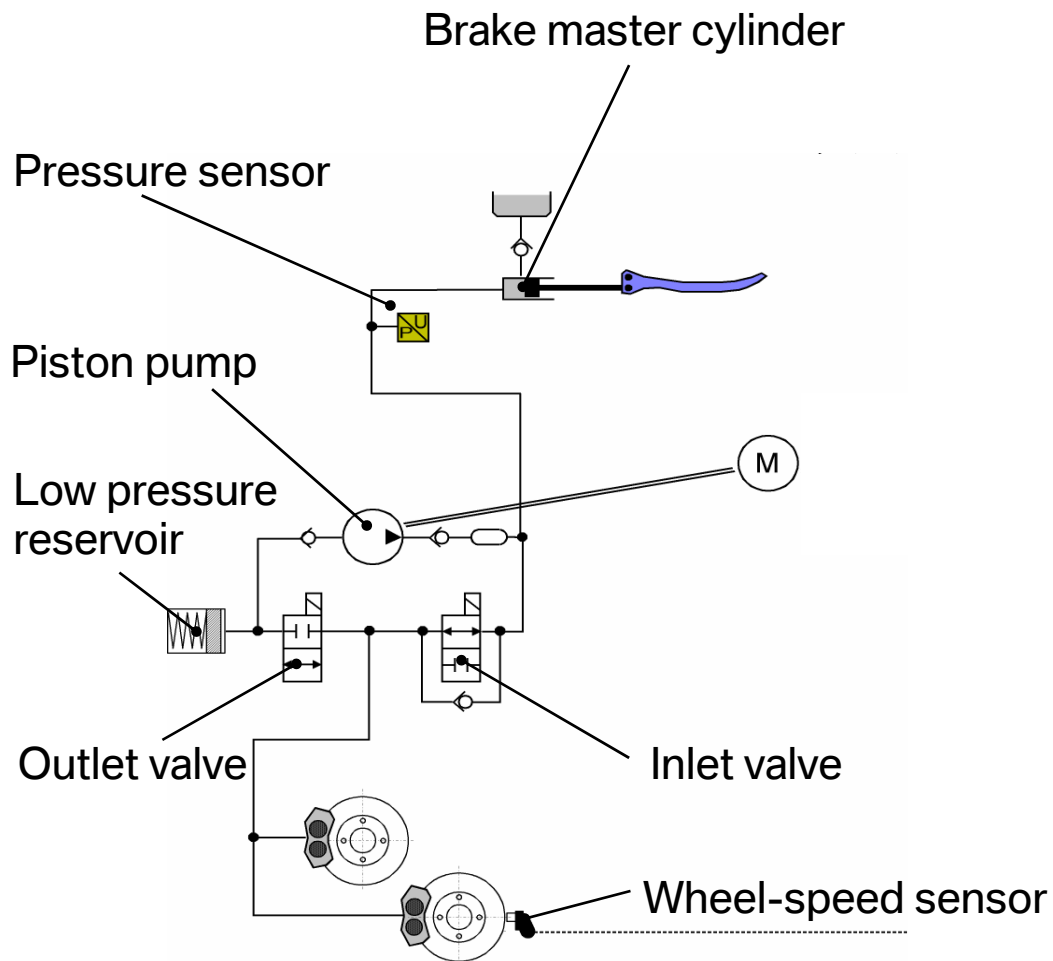
Low pressure  
reservoir





# The new Integral ABS

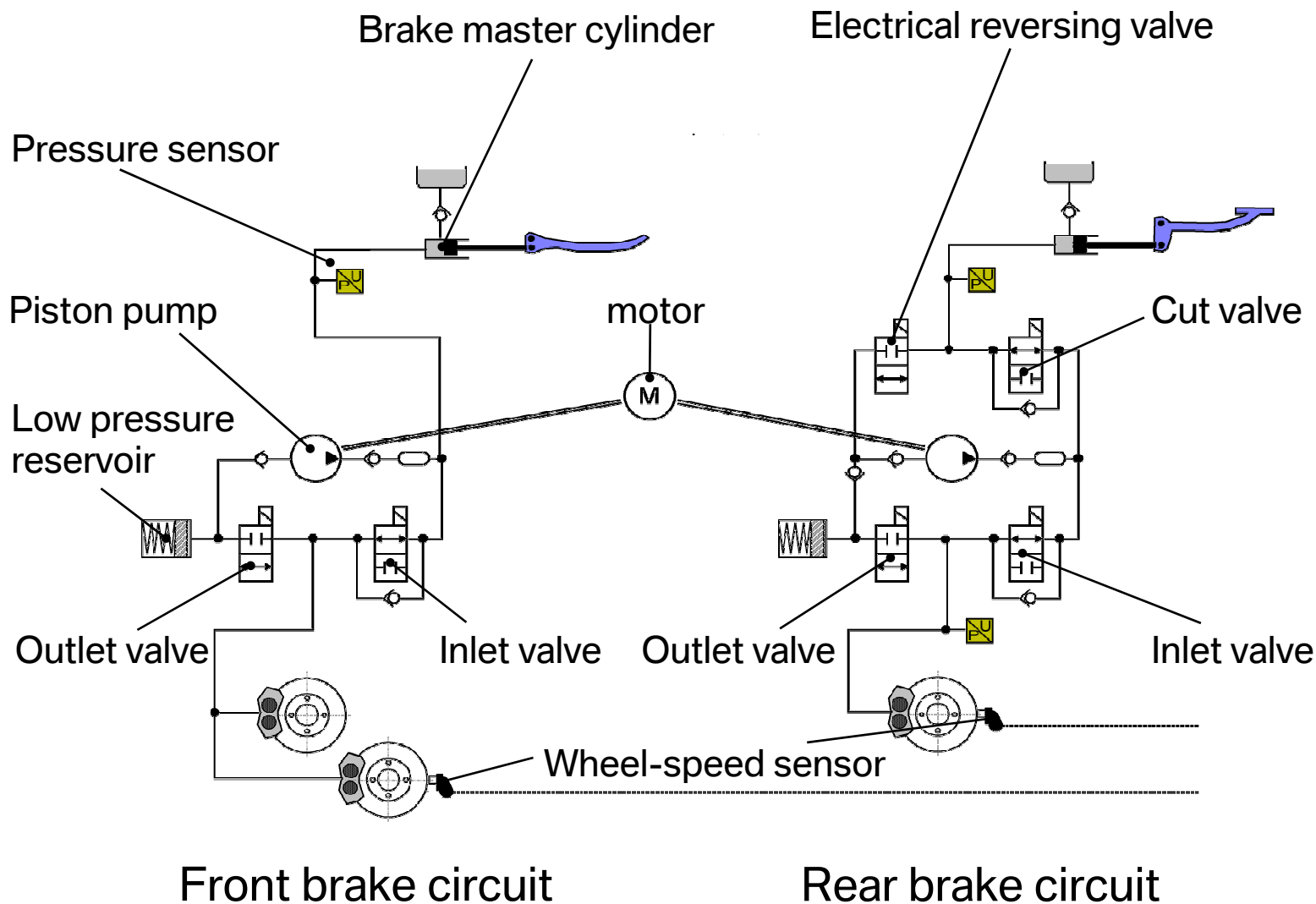
## Hydraulic circuit



Front brake circuit

# The new Integral ABS

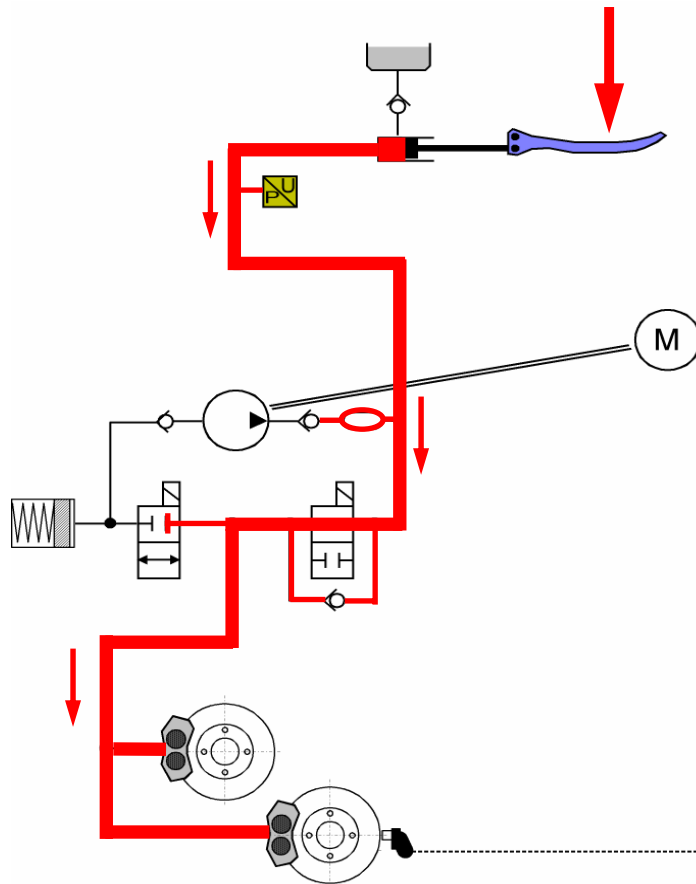
## Hydraulic circuit



# The new Integral ABS

## Hydraulic circuit

**Rider applies front brake**

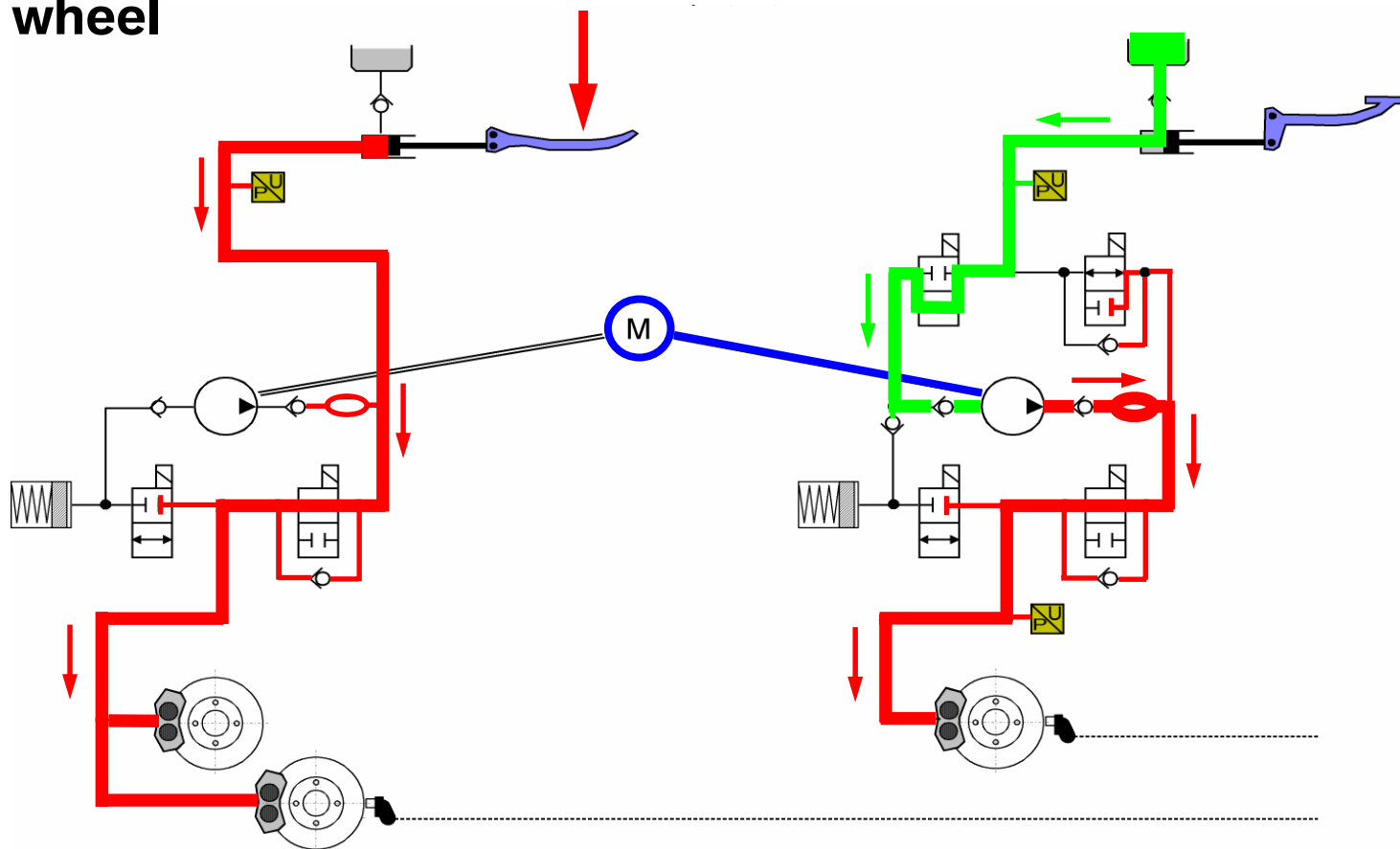


— Pressurized lines

# The new Integral ABS

## Hydraulic circuit

**Rider applies front brake / Active pressure build-up on rear wheel**

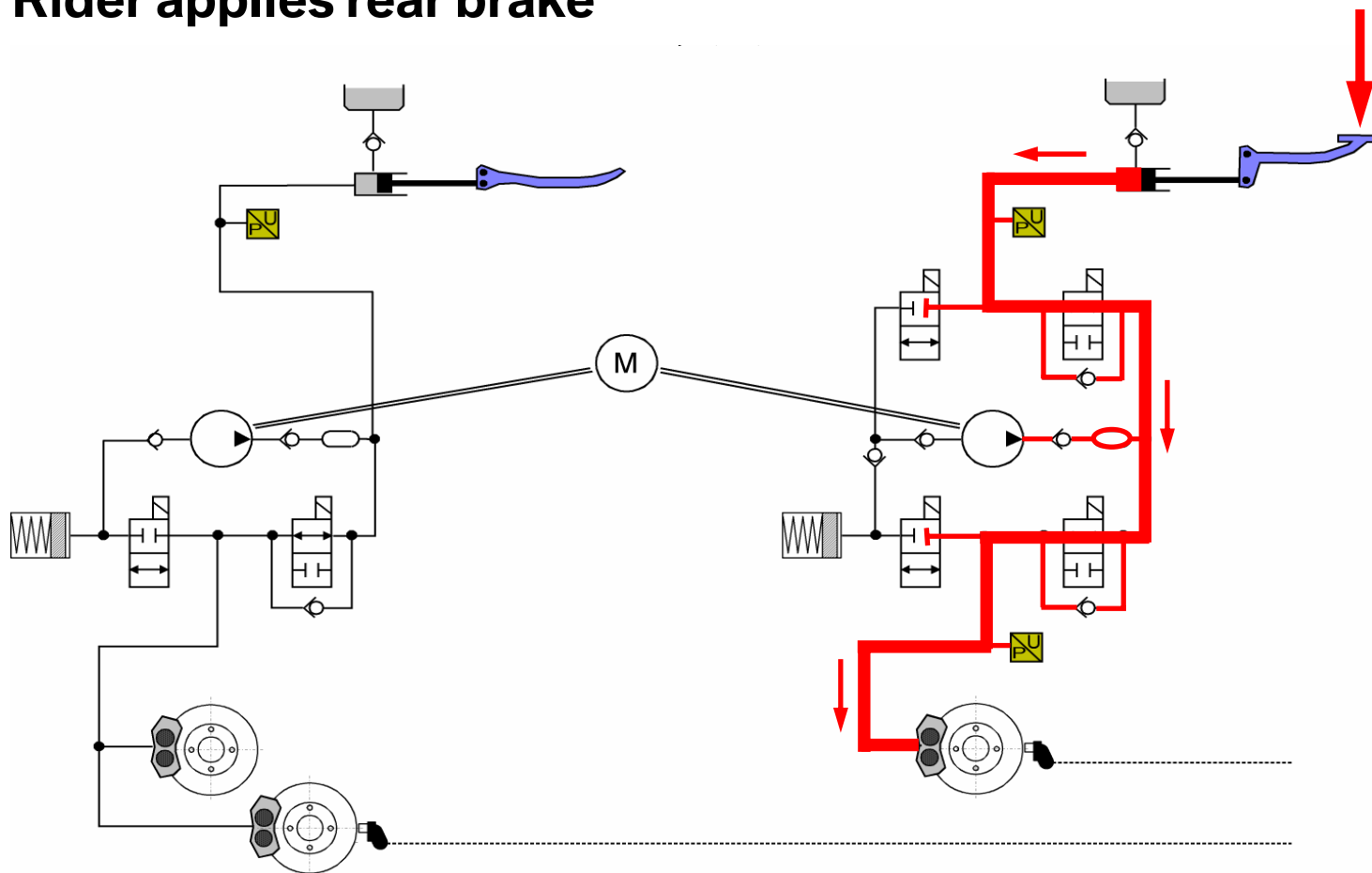


— Pressurised lines  
— Pressure free lines


# The new Integral ABS

## Hydraulic circuit

**Rider applies rear brake**



— Pressurised lines

 Pressurised lines  
 ABS control intervention



The diagram illustrates the hydraulic circuit of an ABS system. It shows a master cylinder (top left) connected to a pump (M) and a reservoir. The pump is connected to a series of solenoid valves (represented by rectangles with arrows) that control the flow of fluid to the wheels. The fluid is shown flowing through the lines, with green arrows indicating the direction of flow. A red arrow points to the master cylinder, indicating the source of pressure. The legend at the bottom right identifies the red lines as 'Pressurised lines' and the green lines as 'ABS control intervention'.

— Pressurised lines  
— ABS control intervention

# The new Integral ABS

## Main features of Integral ABS.

### Concept

- Significantly improved brake feel since there is no brake boost function.
- Improvement of brake performance when maneuvering (ignition off).
- Improved feedback on ABS braking due to analog valves.
- Weight 2.3 kg (5 lbs.).
- Low power input and power requirement.
- Maintenance same as without ABS.

# The new Integral ABS

## Main features of Integral ABS.

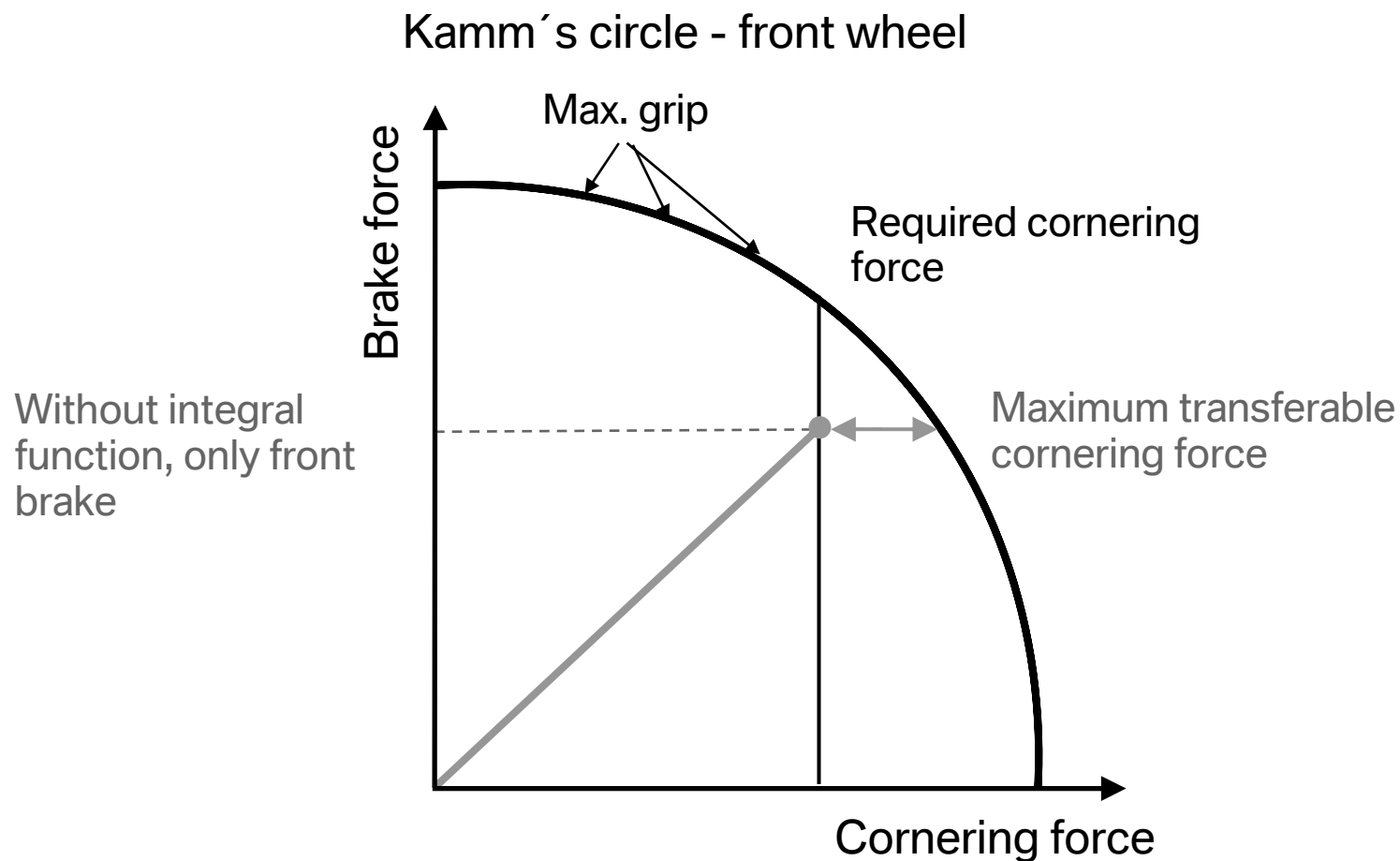
### Function

- Improved use of road surface traction, especially when it changes suddenly.
- Optimized detection and control of rear wheel lift-off.
- Rapid adaptation of optimum brake force distribution to load conditions.
- Extended diagnosis function and system monitoring.
- Data provision by Integral ABS for ASC.
- Can be deactivated for off-road use.

# The new Integral ABS

## Integral function – brake force distribution.

### Braking when leaning

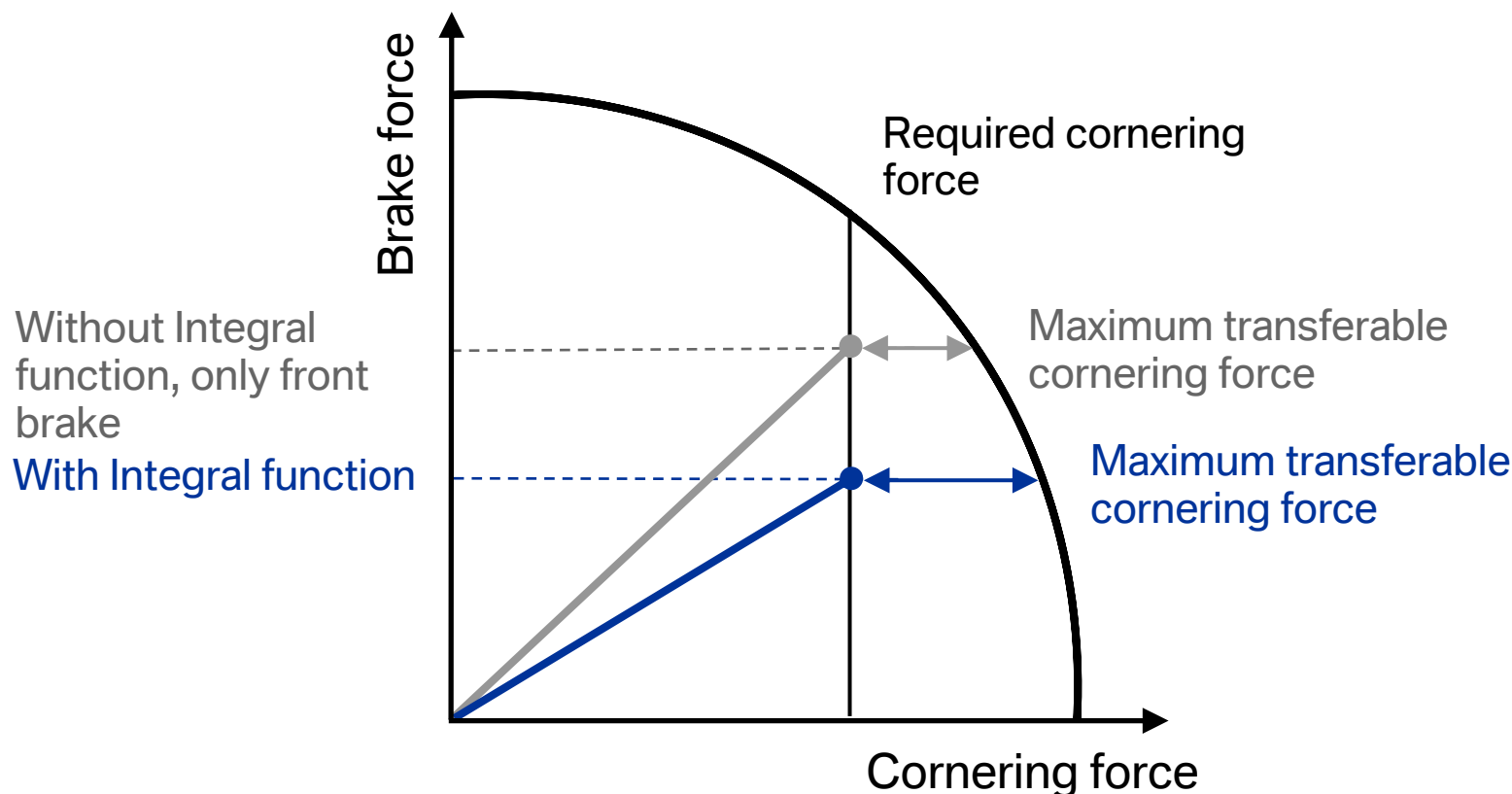


# The new Integral ABS

## Integral function – brake force distribution.

### Braking when leaning

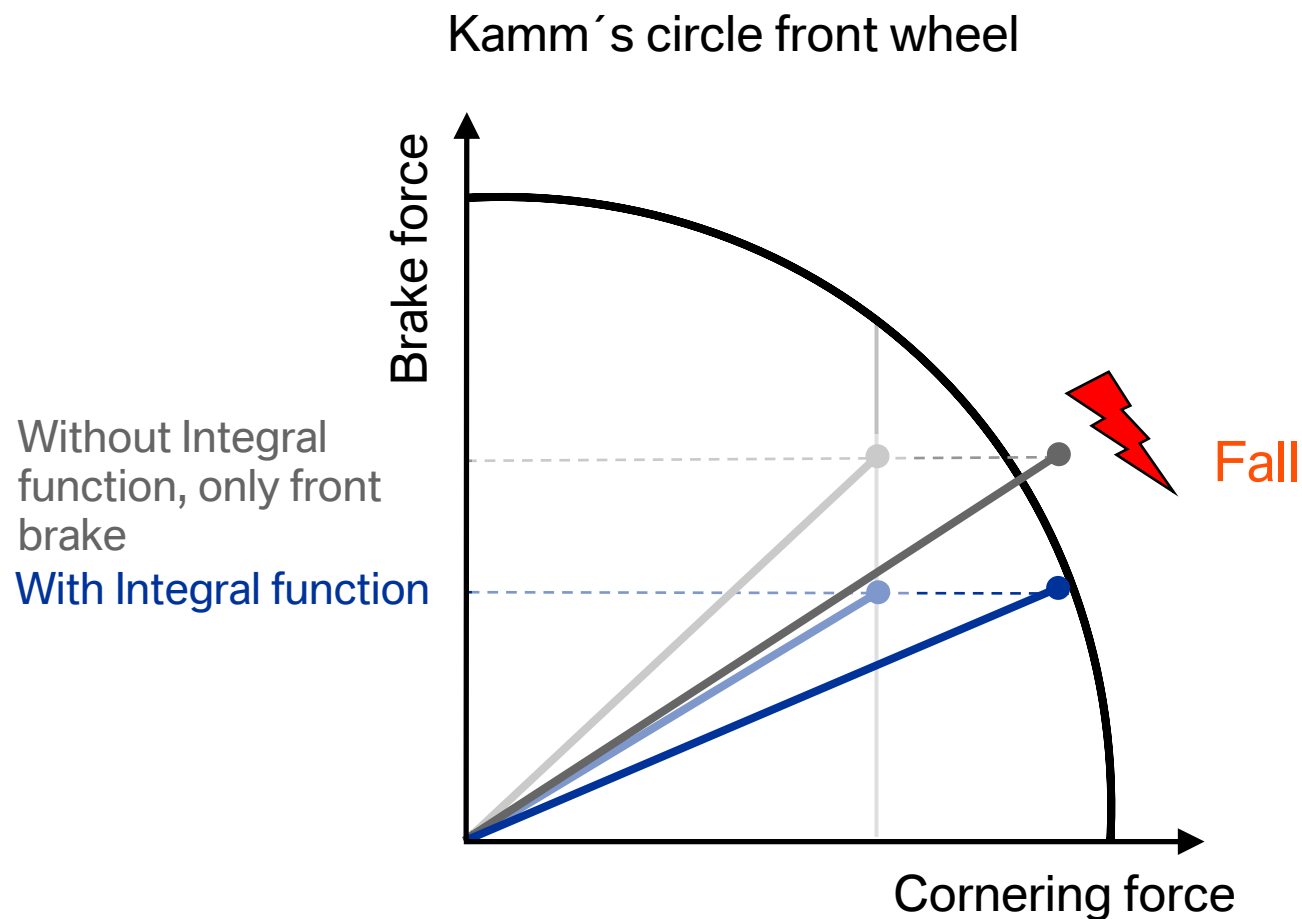
Kamm's circle – front wheel



# The new Integral ABS

## Integral function – brake force distribution.

**Avoid: increased leaning position requirement**

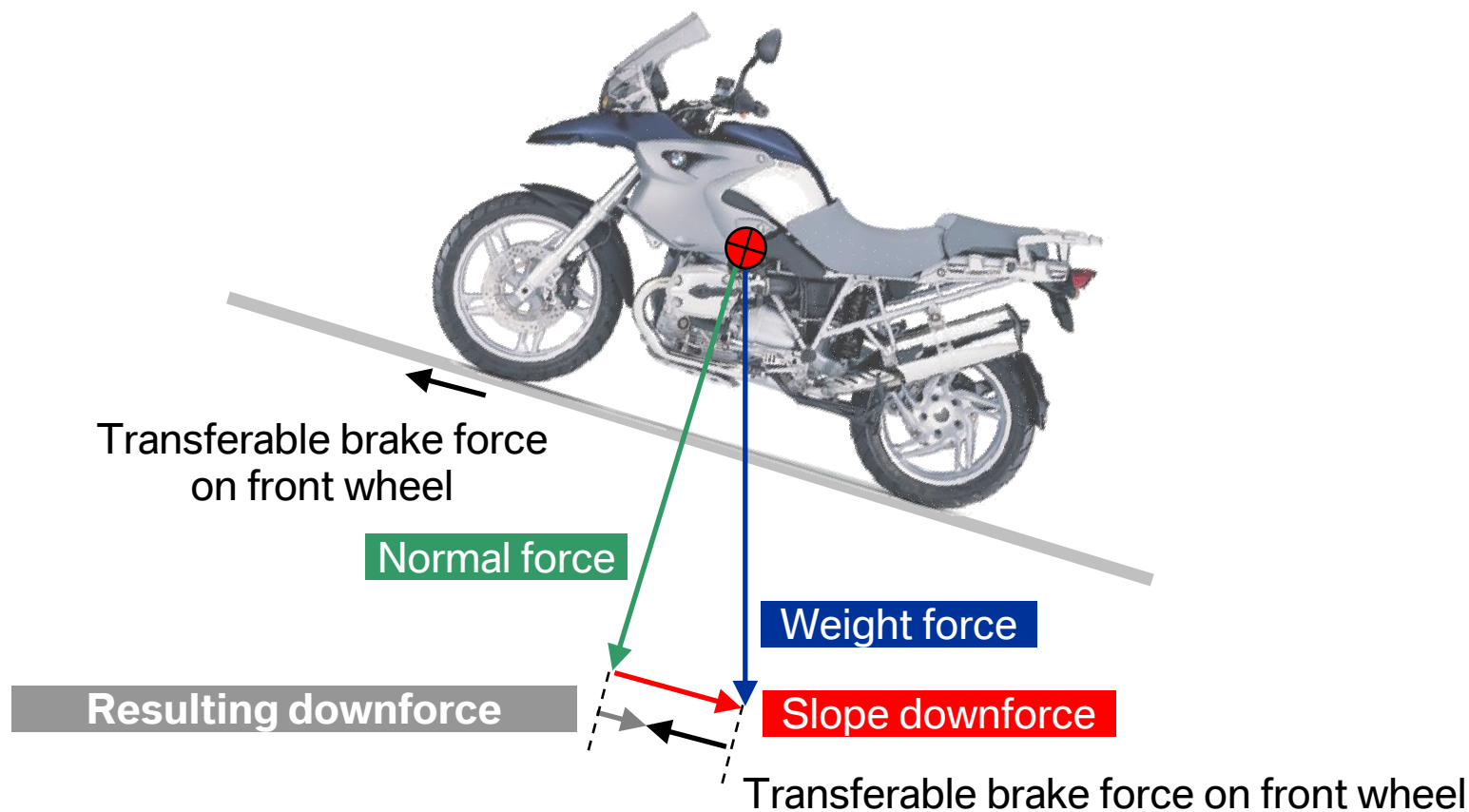




# The new Integral ABS

## Integral function

### Stopping the vehicle on a slope without Integral function

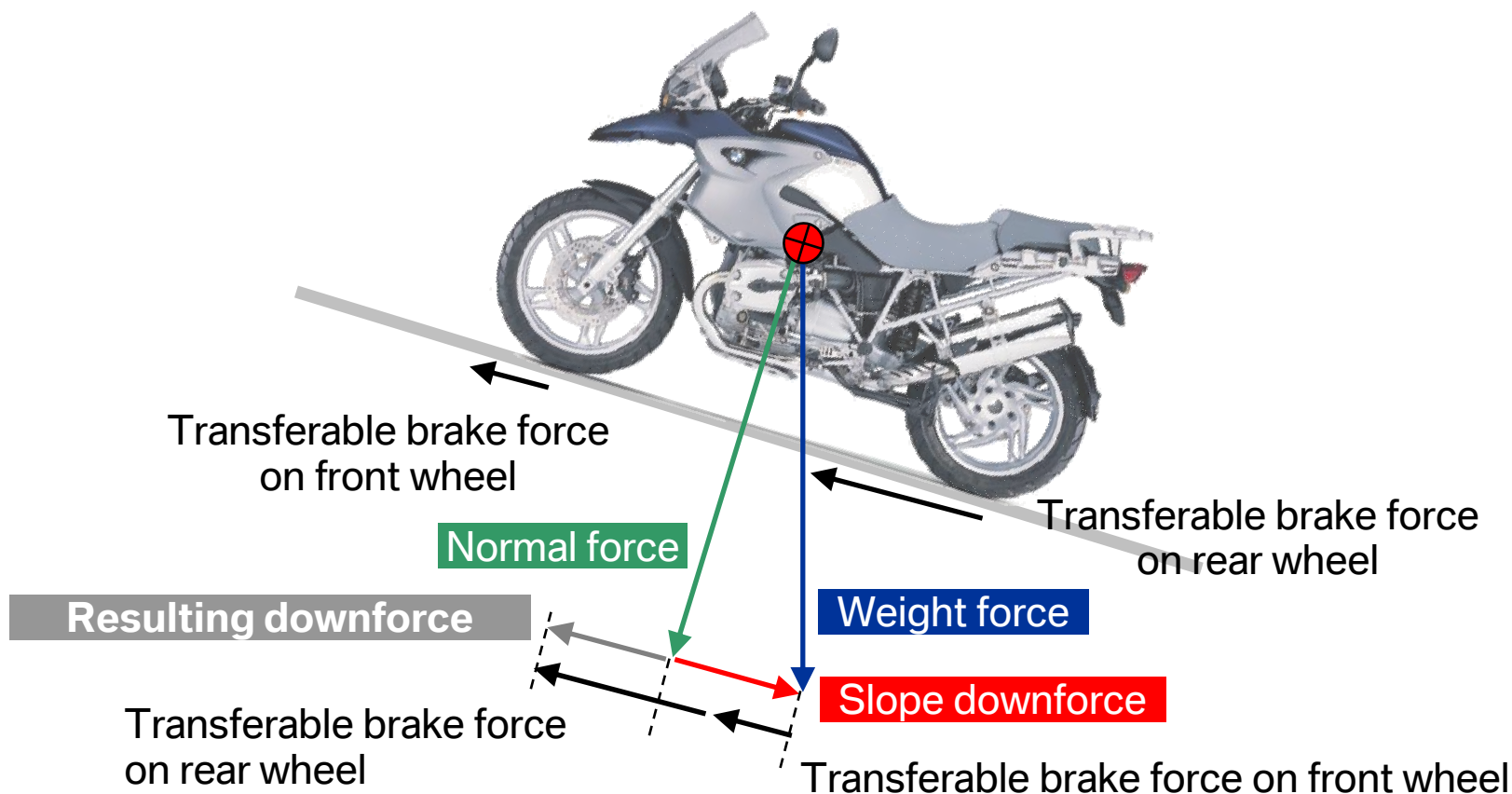


**➡ Motorcycle can slip back with locked front wheel.**

# The new Integral ABS

## Integral function – braking on a gradient.

### Stopping the vehicle on a slope with Integral function



**➡ Motorcycle can be held safely on the slope.**

# The new Integral ABS

## Lift-off detection of Integral ABS.

### Lift-off control



- Rear wheel lift-off is detected by comparing wheel speeds and pressure in the rear wheel circuit.
- When lift-off is detected, brake pressure in front wheel must be reduced.
- This provides stabilization.

# **The new Integral ABS**

## **Complete self-diagnosis of Integral ABS.**

### **Diagnosis capability**

- Self-diagnosis of entire system on system start.
- Continuous self-diagnosis while traveling.
- Constant checking of plausibility for sensor signals.

# **The new Integral ABS**

## **Complete self-diagnosis of Integral ABS.**

### **Diagnosis capability**

- In the event of electrical or electronic failure, control valves are mechanically returned to base position.
- Differentiated deactivation of ABS function and/or integral function.
- Visual display of system failure.
- Immediate direct hydraulic connection between operating function and brake caliper (as for conventional brake system).

# The New ASC (Automatic Stability Control) “Maintain Stability”



**BMW Motorrad**

Washington, DC  
Sept. 2006



**The Ultimate  
Riding Machine**

# Four Wheel vs. Two Wheel Stability Control

Four wheel stability control on automobiles:

- During hard steering or when sliding, 1 front and 1 rear brake are applied (e.g. LF/RR or RF/LR)

Two wheel stability control on motorcycles:

- During hard acceleration, before excessive tire slip, engine power is reduced

# **ASC by BMW Motorrad.**

## **Motivation for ASC (Automatic Stability Control)**

- Tires can only transfer drive torque within physical limits.
- Transferable forces heavily dependent on road surface and environmental conditions (dirt, water, leaves, etc.).
- Riding stability is negatively influenced if there is too much slip.



# **ASC by BMW Motorrad.**

## **Development of ASC.**

### **Development targets of ASC**

- Increase of driving stability.
- Contribution to an increase in active safety.
- Supports rider in accelerating on surfaces which are difficult to estimate or slippery.
- To counteract a rising front wheel when accelerating.

# ASC by BMW Motorrad.

## Development of ASC.

### ASC has not been conceived

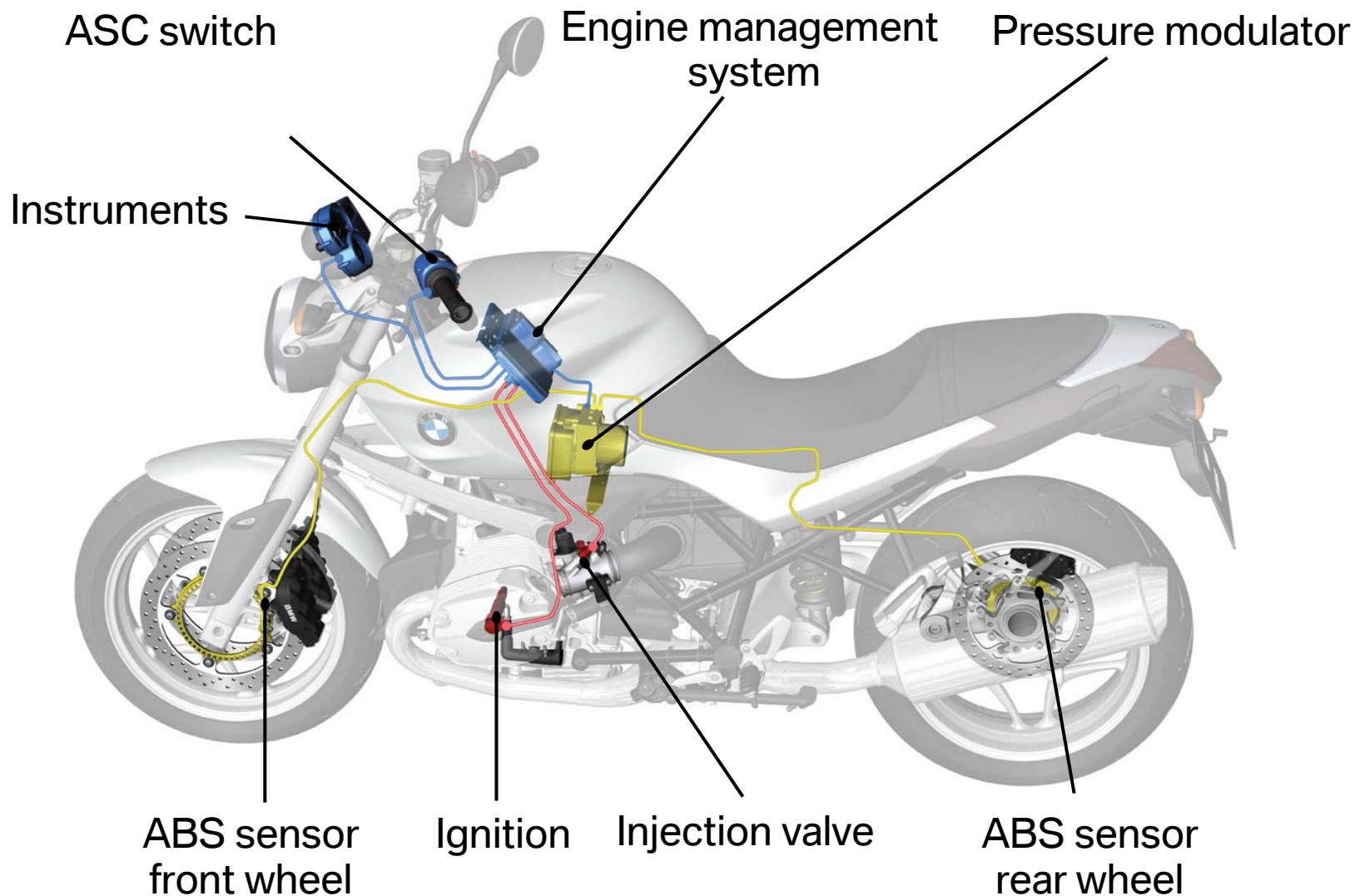
- to achieve the maximum possible acceleration.
- for extreme acceleration from an extreme banking position.

**➡ ASC cannot extend the physical stability limits of a single-track vehicle.**



# ASC by BMW Motorrad.

## System description ASC.



# **ASC by BMW Motorrad.**

## **System description ASC.**

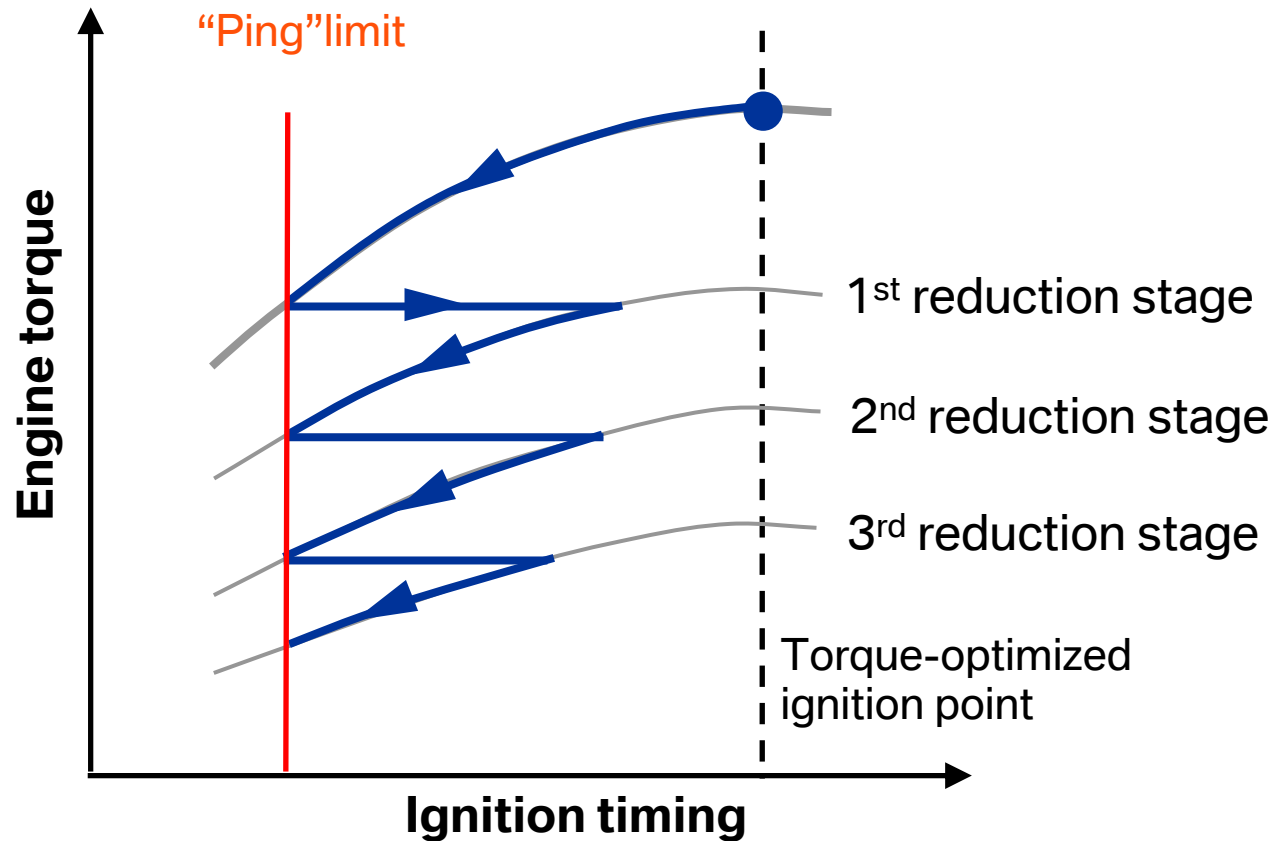
### **Function ASC**

- ABS sensors detect wheel rotation speeds.
- Comparison of wheel rotational speeds gives drive slip.
- If slip is too great, engine torque is limited by engine management system.
- Designed for public road conditions.
- Off-road settings can be activated for off-road use.
- Can be deactivated for sports use.

# ASC by BMW Motorrad.

## System description ASC.

### Torque management



- Torque reduction by adjustment of ignition timing.
- If higher degree of control is required, fuel injection is suppressed.

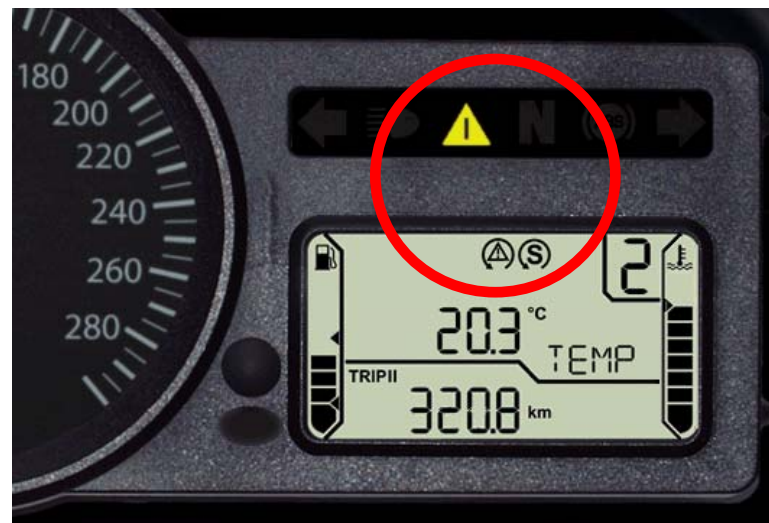
# ASC by BMW Motorrad.

## Operation and display of ASC.

### ASC switch on/off




### ASC display in instrument panel



Display symbols:

 ASC deactivated

 Off-road setting activated

 ASC control

# Thank You!



BMW Motorrad



The Ultimate  
Riding Machine